Farnell

'L' SERIES
BENCH POWER SUPPLIES

LT 30/2
(Op Amps)

INSTRUCTION BOOK

INSTRUCTION BOOK FOR

'L' SERIES
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LT 30/2
(Op Amps)

FARNELL INSTRUMENTS LIMITED-SANDBECK WAY-WETHERBY LS22 4DH-YORKSHIRE-ENGLAND.

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SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When removing the unit from the box, be sure to remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off L series power supply of the model specified

b) 1 off Instruction book

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

This instruction book covers the nine models which comprise the Farnell L series bench power supplies. The circuit diagram in the rear flap refers only to the particular model supplied.

The output voltage is regulated and the unit is protected against overloads and short circuits. Two models feature adjustable overvoltage* crowbar, this additional protection making them suitable for applications involving integrated circuits.

Output is continuously variable by coarse and fine potentiometers and is monitored by a meter which is switched to show either voltage or current. Separate switching of the mains input and d.c. output is provided.

The L12/10C and L30/5 models have facility for remote sensing of the load voltage, and separate meters for monitoring voltage and current. Some models are twin output units and these outputs may be connected in series or parallel to provide twice the voltage or current.

Units available

L50/05	L30/1	L10/3C*	L30/2	L30/5	L12/10C*	LT50/05	LT30/1	LT30/2
0-50V at 500mA	0-30V at 1A	0-10V at 3A	0-30V at 2A	0-30V at 5A	0-12V at 10A	2x0-50V at 500mA	2x0-30V at 1A	2x0-30V at 2A

SPECIFICATION

MAINS INPUT	A.C. mains 110, 130, 220, 240V by internal tap change 50-400Hz
MAINS VARIATION TOLERATED	± 10%
LINE REGULATION OUTPUT CHANGE FOR A ± 10% MAINS CHANGE	Constant voltage less than .01% + 1mV short term Constant current less than .01%+100 μA short term
LOAD REGULATION OUTPUT CHANGE FOR A ZERO TO FULL LOAD CHANGE	Constant voltage less than .01%+2mV short term Constant current less than .01%+100 μA short term
RIPPLE AND NOISE CONTENT AT FULL LOAD (Δf = 80kHz)	Constant voltage less than 1mV pk-pk Constant current less than 0.1% of max. output current
OUTPUT IMPEDANCE (C.V.) TYPICAL	0.1Ω measured at 100kHz and 20°C
TRANSIENT RECOVERY TIME TYPICAL	Less than 25μS for output to recover within 50mV following a 10% - 100% load change of 1μS risetime
TEMPERATURE COEFFICIENT TYPICAL	0.01% per °C
OPERATING AMBIENT TEMPERATURE RANGE	0 to 45°C
STORAGE TEMPERATURE RANGE	−20°C to +50°C
OVERLOAD PROTECTION	Adjustable constant current limiting from 10% to maximum. Current limit indication by L.E.D. mounted in the OUTPUT ON/OFF switch bezel. Automatically resets. L10/3 and L12/10 have over -voltage crowbar adjustable 3.2V to 120% Vout max. Trip coefficient 0.02% per °C typical. Fuse protection input and output. Input fuse labelled 'TYPE T' (time-lag) plus value. Output fuse labelled 'TYPE F' (fast acting) plus value. Both are on the underside of the unit.

STABILITY

Output variations are due in the main to the following causes:-

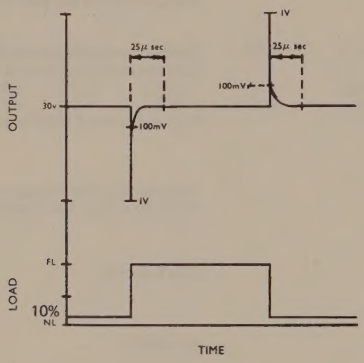
a) Load change
b) Mains supply change
c) Component temperature change

a) Load change

i) Steady load – For a change in steady load from zero to full load the typical change in output is 1mV at full output voltage.

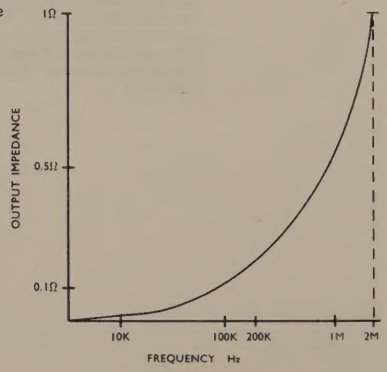
ii) Transient response – The typical response to a pulsed load is shown in fig. 1.

Fig. 1 Pulse response



iii) Output impedance – For an alternating load superimposed on a steady load, the output impedance of the supply increases with frequency due to the fall off in gain of the amplifier until it is determined only by the output capacitor across the output terminals. A typical output impedance against frequency curve is shown in fig. 2.

Fig. 2 Output impedance



b) Mains supply change

Short term variations of up to 10% give corresponding variations of up to 0.01% on the output. Surges on the mains supply in the form of short rise time pulses can be fed on to the output by stray capacity. Where these conditions exist a suppressor filter should be connected to the mains lead.

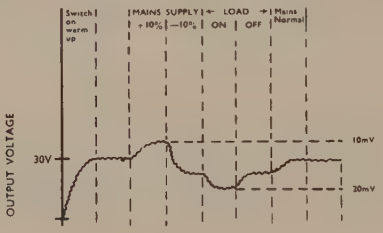
c) Component temperature change

Output variation is caused by component value changes due to temperature change. The temperature change can be i) as a result of ambient change or ii) as a result of internal temperature change, caused by changing internal dissipation from a change in load or supply to the unit.

i) Ambient change — The typical temperature coefficient of output voltage is 0.02% per °C of ambient change with constant load and line

ii) Internal change — Fig. 3 shows typical output variations caused by mains change and load change plotted against time at constant ambient temperature.

Fig.3



OPERATING INSTRUCTIONS

Installation

Units are normally supplied for 240V operation. 220 and 110 volts input units will have an appropriate label attached to the rear panel.

The fixed mains lead supplied is colour coded:-

Live	Brown
Neutral	Blue
Earth	Green/Yellow

Operating instructions

CONSTANT VOLTAGE MODE

Before connection to the mains supply is made the 'OUTPUT ON/OFF' switch should be set to 'OFF'.

Connect the unit to the mains supply and switch the 'MAINS ON/OFF' switch to the 'ON' position. The mains indicator L.E.D. located in the INPUT ON/OFF switch bezel should light.

Set the 'METER' switch to 'VOLTS'. Set current 'LIMIT' control to maximum (fully clockwise). Adjust the 'COARSE' and 'FINE' controls until the required output voltage is indicated by the meter. Unless the current limiting facility is to be used the supply may now be connected to the load via suitable leads by setting the 'OUTPUT' switch to 'ON'. Output current can be monitored by setting the 'METER' switch to 'CURRENT'.

Current limit setting

If a certain maximum current must not be exceeded then the setting-up procedure is as follows:-

With the mains supply connected to the unit, 'MAINS' and 'OUTPUT' switches set to 'ON', the 'METER' switch set to 'CURRENT' and the voltage controls set to the required value, connect a variable load to the output terminals and adjust it so that the required maximum current is indicated on the meter. The current 'LIMIT' control is then adjusted until the current just starts to fall. The current limiting circuitry will not allow higher currents to be drawn. It is normal practise to set the current ceiling approximately 10% in excess of the expected maximum, to prevent any modification to the voltage regulation characteristic. The variable load is now disconnected and the unit is ready for use.

When the unit is operating in its current limit mode, indication is provided by the 'I. LIMIT' L.E.D. located in the OUTPUT ON/OFF switch bezel.

CONSTANT CURRENT MODE

Approximate

With the mains supply connected to the unit, 'MAINS' and 'OUTPUT' switches set to 'ON', the 'METER' switch set to 'CURRENT' and the output voltage controls set to maximum, link the positive output terminal to the negative output terminal and set the current 'LIMIT' control to indicate the required current. Remove the link across the output terminals and connect the supply to the load via suitable leads. The unit will give a roughly constant current if the load resistance falls within the range zero Ω to $\frac{Vmax}{Iset}$ where Vmax. is the unit maximum output voltage and Iset is the current setting.

Accurate — (see table 1)

More accurate constant current than that provided by the current limit control can be obtained by using the constant voltage control system to maintain constant voltage across an external sensing resistor Rs which monitors load current.

The procedure is as follows:-

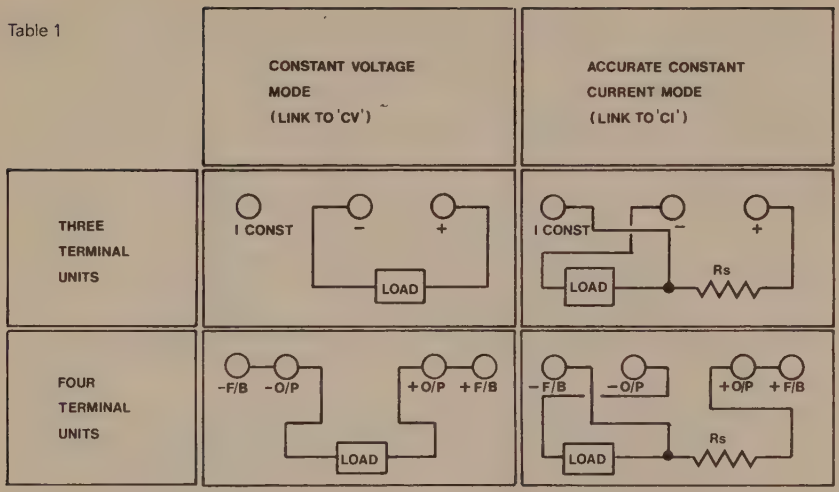
1. Set the CV/CI switch on the underside of the unit near the front panel terminals to the CI position using a small screwdriver.

WARNING! If the CV/CI switch is in the CI position when the unit is connected for CV operation, the voltage sensing circuit is inoperative and the unit output voltage is only restricted to the internal d.c. unregulated line. It is possible for damage to occur to the load under these conditions. The link should always be returned to the CV position when the accurate constant current is no longer required.

2. Select a sensing resistor (Rs in table 1) such that at the maximum load current (IL max) required, the voltage drop across the resistor is 1 volt.

i.e. $Rs = \frac{1}{IL\ max}$ ohms

Table 1



3. Connect the sensing resistor and load as shown in table 1.
4. Set the supply front panel voltage controls to minimum and the current limit control to maximum.
5. Switch on the supply and, using the front panel fine VOLTAGE control, set the output CURRENT to the required value.

NOTE: a) The stability of the set current is determined by the stability of the chosen sensing resistor as well as unit internal parameters. It is necessary therefore that this resistor is a wire wound type. In order to reduce the effects of self heating it is advisable to use a resistor of higher dissipation rating than that given by $(I_L max)^2 R_S$. As a general guide the sense resistors should have a rating at least five times the operational dissipation figure.

b) For correct operation the sum of voltage drops across the sensing and load resistors should be less than the unit maximum quoted output voltage rating.

GENERAL

Remote sensing

The higher current models in the range have been provided with four terminal output, two marked 'OUTPUT' and two marked 'FEEDBACK'. The terminals are colour coded red and black in both cases to indicate positive and negative terminals respectively.

The feedback terminals are used to sense the voltage at the load itself, and the feedback signal obtained is used to correct for voltage drop due to the resistance of the load connecting leads. Maximum lead drop should not exceed 10V per lead.

For general use this facility may not be necessary and the links between '+F/B' and '+O/P' and between '–F/B' and '–O/P' may be left in place

When the correction is required the links should be removed. The load is connected to the output terminals as usual and the '+F/B' and '–F/B' terminals are connected to the positive and negative sides of the load via separate wires. It may be necessary to decouple at the load with an electrolytic capacitor.

Overvoltage protection

On units fitted with overvoltage protection the overvoltage trip level adjustment is on the base plate of the unit.

To set a given trip level, set the output voltage to this level and adjust the 'OVERVOLTAGE' control until the output falls to a low level.

Set the 'COARSE' and 'FINE' controls fully anti-clockwise. Switch the 'OUTPUT' or 'MAINS' switch to 'OFF' and then 'ON'. This resets the overvoltage trip. Re-adjust the output voltage controls to give the required operating voltage.

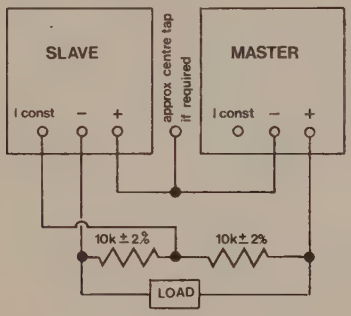
Series operation

Units may only be connected in series when the 'CV' (constant voltage) mode is selected. Any number of units may be connected in series up to a maximum of 500V total output.

Series master/slave operation

Two units may be connected in a series arrangement where the overall output voltage is controlled by one (MASTER) unit, the other (SLAVE) unit holding the common connection of the two supplies at half the overall output voltage.
Connections as follows:

UNITS WITH 3 TERMINALS



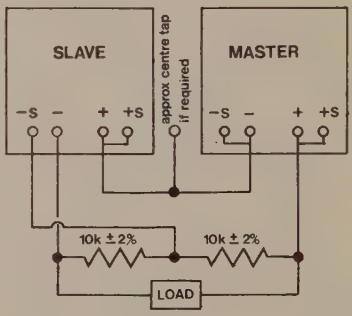
Slave

1. Set CV/CI switch to CI
2. Set voltage controls to zero

Master

1. Set for normal constant voltage operation
2. Voltage controls adjust overall voltage

UNITS WITH 4 TERMINALS



Slave

1. Remove link between –sense and - output terminals
2. Set CV/CI switch to CI
3. Set voltage controls to zero

Master

1. Set for normal constant voltage operation
2. Voltage controls adjust overall voltage

As an alternative, in the above configuration, the master unit can be set for accurate constant current mode to provide a constant current system with twice the voltage compliance of one unit, the master voltage controls providing adjustment of overall current.

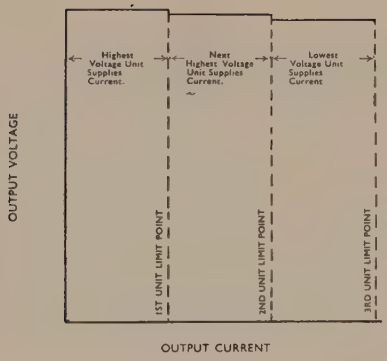
Parallel operation

C.V. mode

Units which are set to approximately the same output voltage may be connected directly in parallel. On increasing load, the unit having the highest output voltage will carry the load until it current limits, thereafter the unit having the next highest voltage will supply the extra current until it limits, and so on. A typical output characteristic for a parallel combination of three units is shown in fig. 4 on page 9.

The characteristic shows a series of descending steps in output voltage at the current limit points of individual units. The amplitude of the steps depends on how closely the output voltages have been set and it may not be possible to adjust this to better than 50mV.

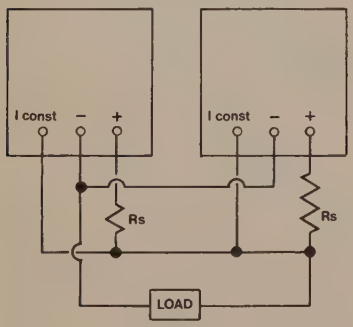
Fig. 4


Highest Voltage Unit Supplies Current.
Next Highest Voltage Unit Supplies Current.
Lowest Voltage Unit Supplies Current
OUTPUT VOLTAGE
1ST UNIT LIMIT POINT
2ND UNIT LIMIT POINT
3RD UNIT LIMIT POINT
OUTPUT CURRENT

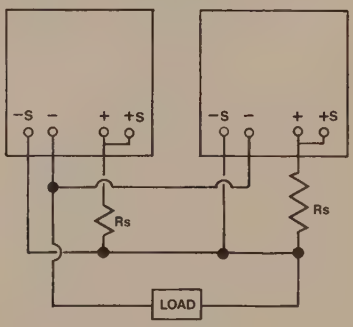
Accurate CI mode

Units connected for accurate CI mode may be connected in parallel, the combined output current being the sum of the individual unit settings.

UNITS WITH 3 TERMINALS



UNITS WITH 4 TERMINALS



CIRCUIT DESCRIPTION

Circuit description

The mains supply is connected via fuse F101 and SW1 to mains transformer TX101. The main secondary of TX101 supplies a bridge rectifier MR101, and reservoir capacitor (s) C102, which provide the main unregulated d.c. line. The positive line is connected, via the series regulator transistor (s) and SW104, to the positive output terminal. The negative line is connected, via fuse F102, to the negative output terminal.

Auxiliary supplies for the control system are derived from the 36V winding on TX101 via rectifier MR1 which feeds reservoir capacitor C2.

The reference voltage is provided by Z4, which is fed from a constant current source, VT1, 2, Z3. A proportion of this voltage, set by the voltage adjust potentiometers P101, 2, provides a variable 0-1mA reference from the current source IC1. This current flowing in R12 enables the voltage across R12 to be varied from 0-Vout maximum.

The voltage comparator half of IC2 compares the voltage across R12 with the output terminal voltage of the unit. The voltage comparator controls VT3 and the regulator transistor(s) to stabilize the voltage at the output terminals.

A proportion of the reference voltage, set by the current limit potentiometer P103, is compared with the voltage across the output current sense resistor(s) by the current limit comparator half of IC2. If the output current exceeds the set level, this amplifier takes over control and holds the output current constant for increasing overload.

Operation of the current limit is shown by the overload indicator, LED 102, driven from the current limit comparator via VT4.

Overvoltage protection (L10/3C and L12/10C only)

A reference voltage is provided by Z302, R304 and R305, driven from the main unregulated d.c. line by the constant current source Z301, VT301 and associated resistors. A proportion of the unit output voltage set by P301,2 is compared with the reference voltage by voltage comparator VT302,3.

If the proportion of output voltage at VT303 base exceeds the reference voltage at VT302 base, VT303 and 304 conduct and SCR101 is gated on. This effectively short circuits the output terminal of the unit.

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect to material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and recalibration it is recommended that the complete instrument be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire.
LS22 4DH
Tel: 0937 63541 Telex: 557294

Service Depot,
Farnell Instruments Ltd.,
2 Orley Court,
Greenford Road,
Harrow, Middx.
HA1 3QD
Tel: 01-864-7433

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

For those who operate their own comprehensive service departments and wish to repair and maintain the equipment themselves, a section on 'internal adjustment' follows.

INTERNAL ADJUSTMENT

It may be that after effecting repairs to active circuitry it becomes necessary to adjust certain internal preset potentiometers. The following procedure should be followed.

Meter zero

In the unlikely event of it being necessary to set meter zero, the adjustment is on the rear of the meter which is accessible through a hole in the control printed circuit board after first removing the top cover of the unit.

Voltage

Set the CV/CI switch to CV

Connect an accurate voltmeter (one which has an f.s.d. compatible with the maximum output voltage of the unit) between the 'O/P-' and 'O/P+' terminals.

Connect unit to mains supply. Switch on both the 'MAINS' and 'OUTPUT' switches. Set the 'COARSE' and 'FINE' controls fully clockwise.

Adjust P2 (on the circuit board) until the maximum output voltage specified for the unit is indicated on the external voltmeter.

Ensure that the 'METER' switch is set to 'VOLTS'. Adjust P1 for full scale deflection of the front panel meter.

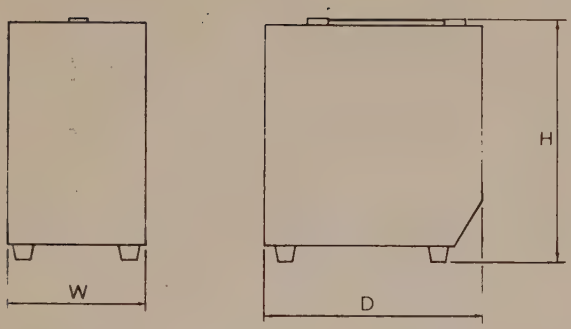
Current

Connect an accurate ammeter, (one which has an f.s.d. compatible with the maximum current available from the unit) in series with a variable load, between the 'O/P+' and 'O/P-' terminals.

Connect unit to mains supply. Switch on both the 'MAINS' and 'OUTPUT' switches. Set the current 'LIMIT' control fully clockwise. Adjust the load until an output current 10% in excess of the maximum specified for the unit is indicated by the external ammeter. Adjust P3 until the current just starts to fall.

Set the 'METER' switch to 'CURRENT'. Re-adjust load to indicate maximum specified output current on the external ammeter. Adjust P4 until the front panel meter indicates full scale deflection.

MECHANICAL DETAILS



Dimensions (mm)

SINGLE UNITS	H	W	D
L50/05 L30/1 L10/3C	226	133.5	225
L30/2	226	133.5	249
TWIN SIZE UNITS	H	W	D
LT50/05 LT30/1	226	254	225
LT30/2	226	254	249
L30/5 L12/10C	226	254	313

NOTES

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FARNELL INSTRUMENTS LIMITED SANDBECK WAY . WETHERBY . YORKSHIRE LS22 4DH . TELEPHONE 0937 63541